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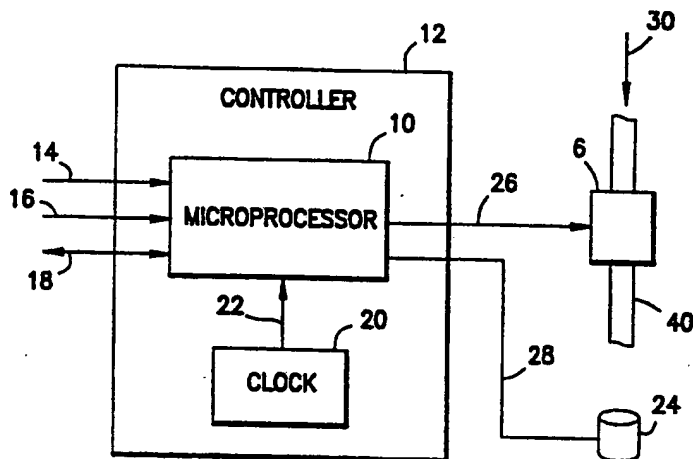
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## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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<b>(21) International Application Number:</b> PCT/US92/09051 <b>(22) International Filing Date:</b> 26 October 1992 (26.10.92) <b>(30) Priority data:</b> 849,750 12 March 1992 (12.03.92) US <b>(71) Applicant:</b> ECOLAB INC. [US/US]; Ecolab Center, St. Paul, MN 55102 (US). <b>(72) Inventors:</b> BRADY, Daniel, F. ; 4277 Suncliff Road, Eagan, MN 55122 (US). MCCALL, John, E., Jr. ; 1936 Nature View Lane, West St. Paul, MN 55118 (US). BAILEY, Clyde, A. ; P.O. Box 263, Hastings, MN 55033 (US). COPELAND, James, L. ; 12729 Pheasant Run, Burnsville, MN 55337 (US).		<b>(74) Agent:</b> HAMRE, Curtis, B.; Merchant, Gould, Smith, Edell, Welter & Schmidt, 3100 Norwest Center, 90 South Seventh Street, Minneapolis, MN 55402 (US). <b>(81) Designated States:</b> AU, CA, DK, FI, JP, NO, UA, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, SE). <b>Published</b> <i>With international search report.</i>

**(54) Title:** SELF-OPTIMIZING DETERGENT CONTROLLER**(57) Abstract**

An apparatus and method for programming a detergent controller (12) to vary the detergent concentration set-point (14) according to the time of day and to achieve detergent concentration levels quickly without incurring overshoot. Thus, the present invention insures that the warewashing machine is operated at optimum efficiency and cost. To vary the set-point according to the time of day, the invention combines the features of a microprocessor, a clock and a controller into one unit. The user enters the time setting (16) and set point into the controller (12). The microprocessor (10) then compares the real-time clock signal with the user time settings and outputs an appropriate set-point value from the microprocessor (10) to the controller (12). To achieve detergent concentration levels quickly without incurring overshoot, the controller (12) senses the detergent concentration and dispenses the proper detergent level to the warewashing machine according to a predetermined detergent feed time based on the previous response time and the programmed set-point (14). Thus, the controller (12) can change the response function if and when conditions change.

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1  
SELF-OPTIMIZING DETERGENT CONTROLLER

BACKGROUND OF THE INVENTION

1. Field of the Invention

5 This invention relates primarily to a method and apparatus for controlling the automatic addition of detergent into a commercial warewashing machine. There are two key problems addressed by the invention. One is the detergent addition itself. The other is the  
10 determination of an appropriate concentration setpoint. By making the detergent feed dependent upon the real-time concentration change rate, detergent overuse is reduced during the detergent addition. Adjusting detergent concentration setpoints to correspond to  
15 changing account conditions also helps to maximize the performance of the warewashing process.

2. Description of Related Art

It is known in the art to provide warewashing  
20 machine systems with detergent controllers. Typically, such systems operate in an on-off mode, proportional mode or a combination thereof. The systems control the detergent concentration level to a pre-set detergent concentration level (set-point). The systems do not  
25 compensate for varying chemical injection rates and therefore exceed this set-point. They indirectly sense detergent concentration by measuring solution conductivity.

The major perceived benefits of this type of  
30 controller is that the addition of, and concentration maintenance of, detergent to the warewashing machine is achieved without manual intervention.

However, these controllers do have some major shortcomings. The detergent concentration set-point  
35 consists of a single pre-set value for all wash cycles. Unless the set-point is manually reset, the wash items are subjected to the same concentrations of detergent in the wash solution, regardless of the meal period or type of soil present on the wash items. Therefore, to be

certain of maintaining an acceptable cleaning result, the setpoint is selected for a worst case condition. This results in detergent overuse. In addition, the detergent controllers feed detergent based on

- 5 proportional control, reacting to the relationship between the setpoint and the current concentration. They do not compensate for the detergent feed rate which also causes detergent overuse or excessive ware on the feeder equipment.

10

#### SUMMARY OF THE INVENTION

- To overcome the limitations in the prior art described above, and to overcome other limitations that will become apparent upon reading and understanding the present specification, the present invention discloses a
- 15 programmable detergent controller for varying the detergent concentration set-point according to the date and time. The controller sensor, a conductivity sensor with an imbedded thermistor, is capable of not only detecting detergent concentration and wash temperature
- 20 but also water changeovers, machine run time, and detergent consumption. The present invention also discloses a programmable detergent controller for optimizing detergent concentration without incurring overshoot. Thus, the present invention insures that the
- 25 warewashing machine is operated at optimum efficiency and cost.

- The present invention combines the features of a microprocessor, clock and controller into one unit. The present invention provides a controller with the ability
- 30 to change detergent concentration set-points according to the time of the day. The present invention also provides a detergent controller with the ability to reach a detergent concentration level quickly without incurring overshoot.

- 35 A feature of the present invention is a controller which may be programmed with a variable detergent concentration set-point. A further feature of the

present invention is a controller which senses the detergent concentration and dispenses the proper detergent amount to the warewashing machine. An advantage of the present invention is the ability to  
5 change the detergent concentration set-point to correspond to the meal period or other special needs. Another advantage of the present invention is the ability to calculate the appropriate detergent feed time based on the rate of detergent concentration change.

10 BRIEF DESCRIPTION OF THE DRAWINGS

Referring now to the drawings in which like reference numbers represent corresponding parts throughout:

Figure 1 is a diagram showing the interconnection  
15 between the warewashing machine and the monitoring system;

Figure 2 is a block diagram of the variable detergent concentration set-point system incorporating a microprocessor, a clock and a detergent on-time  
20 controller; and

Figure 3 is a flow chart diagram describing how the controller calculates the appropriate detergent feed time based upon the previous response and a programmed on-off set-point.

25 DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

In the following description of the preferred embodiment, reference is made to the accompanying drawings which form a part hereof, and in which is shown by way of illustration a specific embodiment in which  
30 the invention may be practiced. It is to be understood that other embodiments may be utilized and structural changes may be made without departing from the scope of the present invention.

The preferred embodiment of the present invention  
35 provides a system to control detergent concentration set-points for warewashing machines with respect to time. The present invention leverages the sensing

capability of the detergent controller by adding a microprocessor and a clock into the controller unit. By programming different detergent concentration set-points for different times of the day, the variable detergent  
5 concentration controller can more effectively remove soil from the wash items.

The preferred embodiment of the present invention also provides a system to control the detergent concentration level without overshooting a pre-set  
10 detergent concentration level. Detergent injection rates vary with temperature, concentration and other factors. The latency time that results from the feeder equipment injection delays and product dissolution rates is not accounted for in previous detergent controllers.  
15 The present invention compensates for any latency time without exceeding the detergent concentration set-point. Those skilled in the art will recognize that the present invention could be used with any type of warewashing machine.

20 Figure 1 discloses the preferred embodiment of the present invention as used in a typical warewashing system. The preferred embodiment includes a detergent controller 12 that incorporates a microprocessor 10 and a clock 20 within a housing unit 8. The controller 12  
25 also includes a solenoid valve 6 within the housing unit 8 to control the detergent feed to the warewashing system.

Figure 2 more particularly illustrates the block diagram of the preferred embodiment as used in a  
30 variable detergent concentration set-point system. The preferred embodiment includes a microprocessor 10 for determining an appropriate detergent concentration set-point. The microprocessor 10 receives two types of inputs from the user. First, a particular detergent  
35 concentration set-point 14 is entered into the microprocessor 10. Then, a user time setting 16 is entered into the microprocessor 10. The user time

setting 16 instructs the microprocessor 10 to begin using the corresponding detergent concentration set-point at the time entered.

Next, the preferred embodiment includes a clock device 20 that provides the microprocessor 10 with a signal corresponding to the date and time 22. The microprocessor 10 compares the date and time signal 22 to the user time setting 16. When the clock date and time signal 22 coincides with the user time setting 16, the microprocessor 10 loads the corresponding detergent concentration set-point 14. The detergent controller 12 uses this corresponding detergent concentration set-point 14 until the microprocessor 10 determines that another set-point should be used. Thus, the controller 12 can be programmed to handle soil loads that vary cyclically with time. The number of time and set-point entries are limited only by the storage capability of the microprocessor.

A sensor 24 routes a measurement of the detergent concentration and temperature information 28 to the microprocessor 10. The sensor 24 preferably comprises a conductivity sensor and an imbedded thermistor. The conductivity sensor signals the detergent concentration 28 by determining conductivity using the measurement of the free ions in the wash tank 40 solution. The imbedded thermistor signals the temperature information 28 by determining the temperature of the wash tank 40 solution.

In the preferred embodiment, the conductivity sensor may be of an electrode or electrode-less type. An electrode-type conductivity sensor is typically comprised of two electrodes immersed in the wash tank 40 solution, wherein the current flow from one electrode to the other electrode corresponds to the conductivity of the solution. An electrode-less conductivity sensor, which operates as a transformer, is typically comprised of a primary coil inducing a current into the wash tank



40 solution and a secondary coil converting the current into a voltage level, wherein the voltage level corresponds to the conductivity of the solution.

The microprocessor 10 uses the conductivity and  
5 temperature information 28 provided by the sensor 24 to determine wash tank 40 changeover, detergent consumption, and detergent feed.

With regard to wash tank 40 changeover, the microprocessor 10 can determine when the wash tank 40  
10 has been recharged with fresh water using the detergent concentration 28. Typically, the same solution is used over and over for multiple racks of dishes. The sensor 24 senses the fresh water because of the resulting change of the solution to a very low conductivity or a  
15 major reduction in conductivity.

With regard to detergent consumption, the detergent concentration 28 from the sensor 24 can also be used to determine when a detergent reservoir is empty. If the sensor 24 detects a decrease in conductivity, even  
20 though the warewashing machine has been instructed to feed detergent into the wash tank 40, then there is probably no detergent being fed into the wash tank 40. However, it could be the situation that someone just recharged the detergent reservoir, but some air has  
25 gotten into the feed line; it is also possible some of the detergent was solidified and it is just eroding slowly in the wash tank 40 solution; or it is possible that there are other causes of low conductivity. Thus, the microprocessor 10 can be programmed not to indicate  
30 an empty detergent reservoir unless the wash tank 40 solution remains at a low conductivity level for some period of time. Other criteria can also be used.

With regard to detergent feed, the microprocessor 10 compares the corresponding detergent concentration set-  
35 point 14 with the detergent concentration 28 from the sensor 24. Based on this comparison, the microprocessor 10 determines when the solenoid valve 6 should be opened

to allow the feeding of detergent solution 30 into the wash tank 40 and sends a open command 26 to the solenoid valve 6.

Figure 3 is a flow chart describing the steps performed by the controller 12 during detergent feed to achieve, yet not exceed, a pre-set detergent concentration level. There must be a balance between overshoot and the need to reach a suitable detergent concentration quickly to insure adequate washing performance on the first items through the process.

Instead of fixed or adjustable crossover points to proportional mode or adjustments to output response protocols, the controller 12 dispenses detergent only by calculating the required feeder on-time, based on the last known flow-rate. After, or in some cases during a detergent feed cycle, the detergent flow-rate is calculated and either the detergent feed time is modified for the current detergent feed cycle or it will be used for the next detergent feed time calculation. This allows the controller to avoid any on-off type proportioning, and instead use derivative control to achieve the detergent concentration setpoint quickly and with minimal overshoot. It also inherently gives the controller 12 the capability to optimize detergent feed for any of a variety of configurations and system lags without the need to predict them in advance. This learning and comparing cycle is performed each time the controller 12 activates a solenoid valve 6, thus allowing a change to the controller 12 response function if and when conditions change, such as water pressure or temperature. The special challenges in the warewashing application require the controller 12 to make up wide differences between the actual detergent concentration 28 provided by the sensor 24 and set-point as quickly as possible, again without exceeding set-point. Aggravating the process is a latency time between activating the detergent feed and reading the detergent

concentration information 28 at the wash tank sensor 24. The detergent feed rate can vary greatly and must be compensated for.

The controller 12 first reads an interrupt condition 50, FLAG 3. FLAG 3 is an indication for the controller 12 to activate the solenoid valve 6 to allow the feeding of detergent solution 30 into the wash tank 40. If FLAG 3 has not been set, then the controller 12 is in the "control" state and the intermediate flow-rate calculation 60 begins immediately. If FLAG 3 has been set, then the controller 12 determines whether the solenoid valve 6 will be activated for longer than 2 seconds 52, given the last known flow-rate (FC), the current detergent concentration (DC) 28 and set-point (DS). If the detergent feed will not be ON longer than 2 seconds, then the controller 12 does nothing 54. If the controller 12 determines that the solenoid valve 6 will be activated for longer than 2 seconds, the controller 12 initiates the output (Detergent Feed) and FLAG 3 is cleared 56. An output ON time (SET-TIME) is then calculated 58.

Next, the intermediate flow-rate calculation is initiated 60. If the controller 12 determines that the flow-rate has increased to the point where overshoot occurs, then the detergent feed is terminated 62. If the flow-rate has not increased, the accumulated ON time (Ta) is incremented 64 and compared with the SET-TIME 66. If the accumulated ON time is not greater than the SET-TIME, then the flow-rate calculation continues. However, if the accumulated ON time is greater than the SET-TIME, the detergent feed is terminated 62. Whenever the detergent feed is terminated in the above steps 62, the OFF-TIME timer (To) is incremented 68 and the controller 12 determines whether the flow-rate should continue to be calculated 70 by determining whether FLAG 2 has been set. If FLAG 2 has not been set, the flow-rate calculation continues 72. Otherwise, the remaining

OFF-TIME is compared to the latency time as discussed below 90. When the flow-rate calculation is resumed 72, the detergent concentration 28 is read every 0.1 seconds. The value of the detergent concentration 28 is then stored in a memory location indicated by a pointer A 72. The pointer A is then incremented to the next memory location so that the number of stored detergent concentration 28 values can be counted 74. Once thirteen detergent concentration 28 values have been stored (A>12), then an intermediate flow-rate (Fco) is calculated 76. If Fco has not exceeded 35 microsiemens per second or FLAG 1 is not set 78, the flow-rate is deemed to have not changed and the latency time (LT) is incremented 80. The maximum latency time permitted is 20 seconds. If the output is ON and some latency time has accumulated, but not exceeding 20 seconds 82, then intermediate flow-rate calculation is repeated (back to 60). If the flow-rate is deemed to have changed or if the latency time is greater than 20 seconds, the flow-rate is set to the latest flow-rate 84 and FLAG 1 is set to stop accumulating latency time. With the output OFF, the latency time (LT) and flow-rate (FC) calculations continue if there are more than 2 seconds of OFF-TIME (To) remaining 86 and the OFF-TIME is not greater than the latency time 90. If there are not more than 2 seconds of OFF-TIME remaining 86, then FLAG 2 is set 88. If the OFF-TIME is greater than the latency time 90, the flow-rate is cleared 92. The accumulated on-time, off-time, the storage device, FLAG 1, and FLAG 2 are also cleared 92. The latency time is then reset to one 94. Finally, FLAG 3 is set 96 and recalculation begins again 52 by determining if the detergent feed will be on longer than two seconds, given the last know flow-rate (FC), the current detergent concentration (DC) 28 and set-point (DS).

In summary, the present invention is a detergent controller having the ability to change the detergent

concentration set-point to correspond to meal periods, as well as weekend and holiday workloads. The invention incorporates a microprocessor, a clock and controller in one unit. Thus, in addition to detecting and recording  
5 warewashing machines performance data, the unit can be programmed to control different set-points at different time settings. The present invention also controls detergent levels by balancing overshoot of the detergent set-point with the need to reach a suitable detergent  
10 concentration quickly. By optimizing the detergent concentration level without incurring overshoot, the controller insures adequate washing performance on the first items through the process, and reduces chemical feeder wear.

15 The foregoing description of the preferred embodiment of the invention has been presented for the purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise form disclosed. Many modifications and  
20 variations are possible in light of the above teaching. It is intended that the scope of the invention be limited not by this detailed description, but rather by the claims appended hereto.

Those skilled in the art will recognize that the  
25 present invention could be used with different components or combinations of components than those described above. Those skilled in the art will also recognize that other user interfaces and storage devices and different combinations thereof, could be substituted  
30 for the interfaces and storage devices used in the preferred embodiment.

## WHAT IS CLAIMED IS:

1. An apparatus for controlling variable detergent concentration levels in a warewashing machine,  
5 comprising:  
    data entry means for entering at least one user time setting and a set-point value corresponding thereto;  
    timer means for providing a real-time clock signal;  
    processing means for receiving the user time  
10 settings, corresponding set-point values, and real-time clock signal, and for comparing the real-time clock signal with the user time settings and outputting the corresponding set-point value;  
    sensor means for measuring a detergent concentration  
15 level of a wash tank solution;  
    controller means for receiving and comparing the outputted set-point value from the processing means and the measured detergent concentration level from the sensor means, and for generating a signal to control the  
20 detergent concentration level in the wash tank solution in response thereto; and  
    means for regulating a detergent feed on-time based on the comparison of the detergent concentration level to the set-point value.  
25
2. The apparatus of claim 1; wherein the set-point value comprises a desired conductivity value based upon a type of soil expected for a particular time setting.
- 30 3. The apparatus of claim 1, wherein the user time setting comprises a year, month, day, hour, minute and second entry.
4. The apparatus of claim 1, wherein the data entry  
35 means comprises a keypad and a display.

5. The apparatus of claim 1, wherein the sensor means further comprises means for sending signals based upon a conductivity of the wash tank solution to the processing means.

5

6. The apparatus of claim 5, wherein the processing means further comprises means for detecting wash tank changeovers, detergent feed, and detergent consumption based upon the conductivity signals received from the sensor means.

10

7. The apparatus of claim 1, wherein the sensor means further comprises means for sending signals based upon a temperature of the wash tank solution to the processing means.

15

8. A method of varying detergent concentration levels in a warewashing machine, comprising the steps of:

- 20 entering at least one user time setting and a set-point value corresponding thereto;  
providing a real-time clock signal;  
comparing the real-time clock signal with the user time settings and outputting the corresponding set-point  
25 value;  
measuring a detergent concentration level of a wash tank solution;  
receiving and comparing the outputted set-point value and the measured detergent concentration level,  
30 and generating a signal to control the detergent concentration level in the wash tank solution in response thereto; and  
regulating a detergent feed on-time based on the comparison of the detergent concentration level to the  
35 set-point value.

9. The method of claim 8, wherein the set-point value is a desired conductivity value based upon a type of soil expected for a particular time setting.

5 10. The method of claim 8, wherein the step of entering the user time setting further comprises the step of entering a year, month, day, hour, minute and second value.

10 11. The method of claim 8, further comprising the step of detecting wash tank changeovers, detergent feed, and detergent consumption based upon a conductivity of the wash tank solution.

15 12. An apparatus for optimizing detergent concentration in a warewashing machine with minimal overshoot, comprising:

means for determining whether a detergent needs to be added to a wash solution;

20 means for feeding the detergent into the wash solution;

sensor means for measuring a detergent concentration in the wash solution;

25 means for calculating a rate of increase for the detergent concentration in the wash solution; and

means for terminating the means for feeding based on the rate of increase for the detergent concentration in the wash solution.

30 13. The apparatus of claim 12, wherein the means for terminating further comprises means for discontinuing the means for feeding when overshoot in the detergent concentration is anticipated based upon the rate of increase.

35

14. The apparatus of claim 12, wherein the means for terminating further comprises:



14

means for incrementing an accumulated on-time measurement;

means for calculating an on-time;

means for comparing the accumulated on-time with the  
5 calculated on-time; and

means for ending the detergent feed when the accumulated on-time is greater than the calculated on-time.

10 15. The apparatus of claim 14, wherein the means for ending further comprises:

means for advancing an off-time timer;

means for resolving whether a flag indicating cessation of the detergent feed has been set; and

15 means for continuing the means for feeding when the flag has not been set.

16. The apparatus of claim 12, wherein the means for terminating further comprises:

20 means for deciding whether a predetermined number of detergent concentration values have been stored in a memory device;

means for computing an intermediate detergent flow-rate once the predetermined number of detergent

25 concentration values have been stored;

means for ascertaining whether the computed intermediate detergent flow-rate has changed; and

means for setting the intermediate detergent flow-rate to the latest calculated detergent flow-rate when  
30 the intermediate detergent flow-rate has changed.

17. The apparatus of claim 16, wherein the means for deciding further comprises:

means for establishing the detergent concentration  
35 once every predetermined interval;

means for storing the detergent concentration in the memory device;

15

means for incrementing a register of the memory device; and

means for recalculating the intermediate detergent flow-rate when less than the predetermined number of  
5 detergent concentration values have been stored.

18. The apparatus of claim 16, wherein the means for ascertaining further comprises:

means for increasing a latency time when the  
10 intermediate detergent flow-rate has not changed;

means for discovering whether an accumulated latency time exceeds a predetermined period of time;

means for recomputing the intermediate detergent flow-rate when the predetermined period of time has not  
15 occurred;

means for fixing the intermediate detergent flow-rate to the latest computed detergent flow-rate when the latency time exceeds the predetermined period of time; and

20 means for resetting the intermediate detergent flow-rate when the off-time is not greater than the latency time.

19. A method for optimizing detergent concentration  
25 without incurring overshoot, comprising the steps of:

determining whether a detergent feed will be on for longer than a predetermined period of time;

calculating an on-time when the detergent feed will be on for more than the predetermined period of time;

30 ascertaining whether a detergent flow-rate will cause overshoot in the detergent concentration when sustained for the calculated on-time;

initiating the detergent feed at the detergent flow-rate when the on-time is greater than the predetermined  
35 period of time;

measuring an accumulated on-time for the detergent feed;

measuring a detergent concentration change in the wash solution;

re-computing the detergent flow-rate based upon the accumulated on-time and the measured detergent

5 concentration change; and

repeating the determining step (a) through the computing step (g).

20. The method of claim 19, wherein the step of  
10 ascertaining whether the detergent flow-rate causes overshoot further comprises the step of terminating the detergent feed when overshoot in the detergent concentration is anticipated.

15 21. The method of claim 19, wherein the step of measuring the accumulated on-time further comprises the steps of:

incrementing an accumulated on-time measurement;

computing a calculated on-time;

20 comparing the accumulated on-time with the calculated on-time; and

ending the detergent feed when the accumulated on-time is greater than the calculated on-time.

25 22. The method of claim 19, wherein the step of re-computing the flow-rate further comprises the steps of:

discovering whether a predetermined number of detergent concentration values have been stored in a memory device;

30 figuring an intermediate detergent flow-rate once the predetermined number of detergent concentration values have been stored;

resolving whether the calculated intermediate detergent flow-rate has changed; and

35 setting the intermediate detergent flow-rate to the latest calculated detergent flow-rate when the intermediate detergent flow-rate has changed.

23. The method of claim 22, wherein the step of discovering whether the predetermined number of detergent concentration values have been stored further  
5 comprises the steps of:

ascertaining the detergent concentration once every predetermined interval;

storing the concentration detergent value in the memory device;

10 augmenting a register of the memory device; and  
recomputing the intermediate detergent flow-rate when less than the predetermined number of detergent concentration values have been stored.

15 24. The method of claim 23, wherein the step of resolving whether the calculated intermediate detergent flow-rate has changed further comprises the steps of:

adding to a latency time when the intermediate detergent flow-rate has not changed;

20 determining whether an accumulated latency time exceeds a predetermined period of time;

recomputing the intermediate detergent flow-rate when the predetermined period of time has not occurred;

25 setting the intermediate detergent flow-rate to the latest calculated detergent flow-rate and setting a third flag when the latency time exceeds the predetermined period of time; and

refiguring the intermediate detergent flow-rate when the off-time is not greater than the latency time.

30

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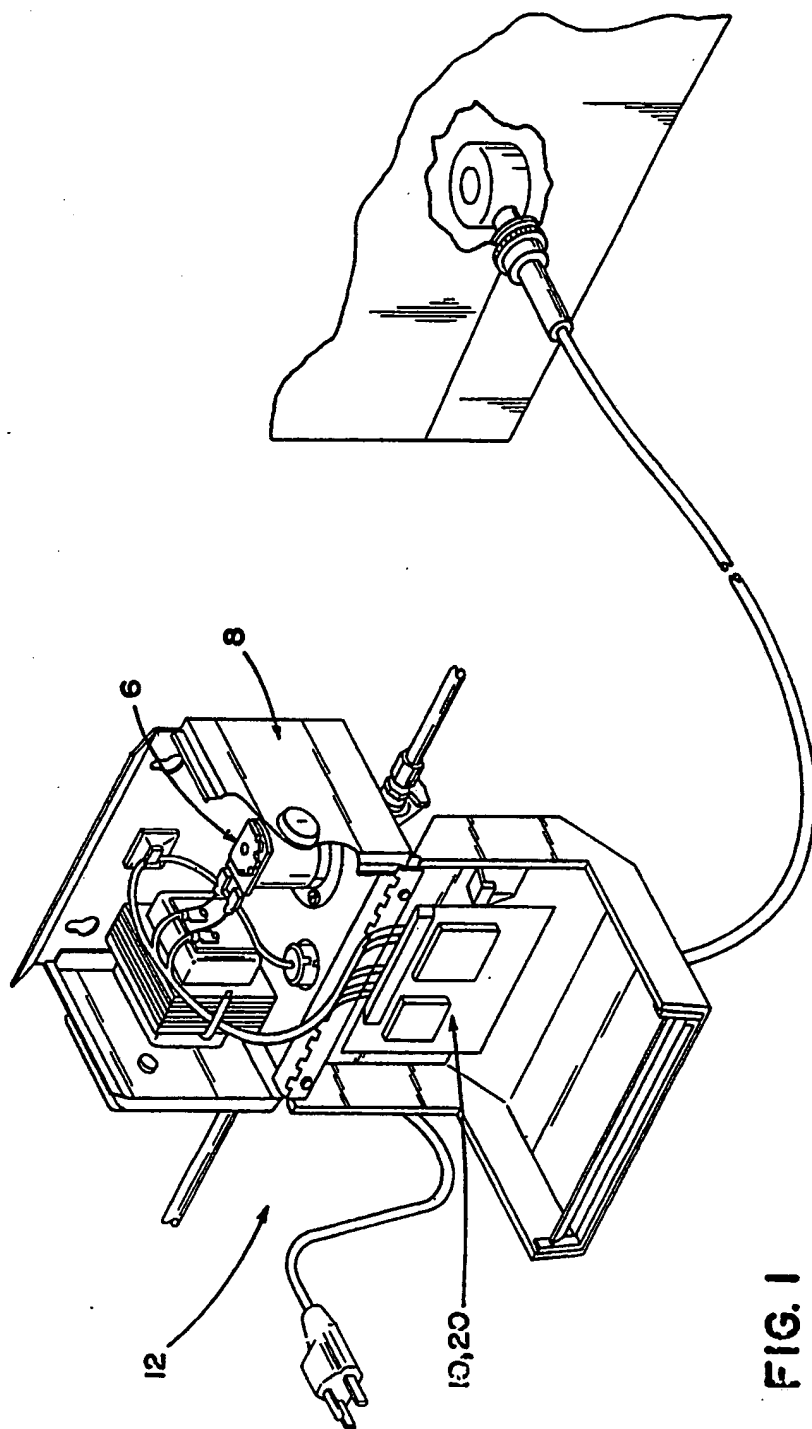


FIG. 1

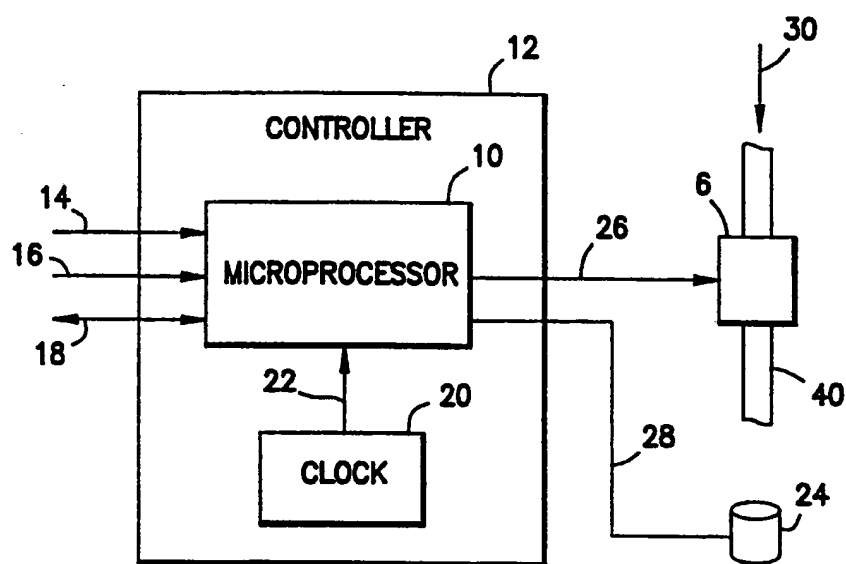
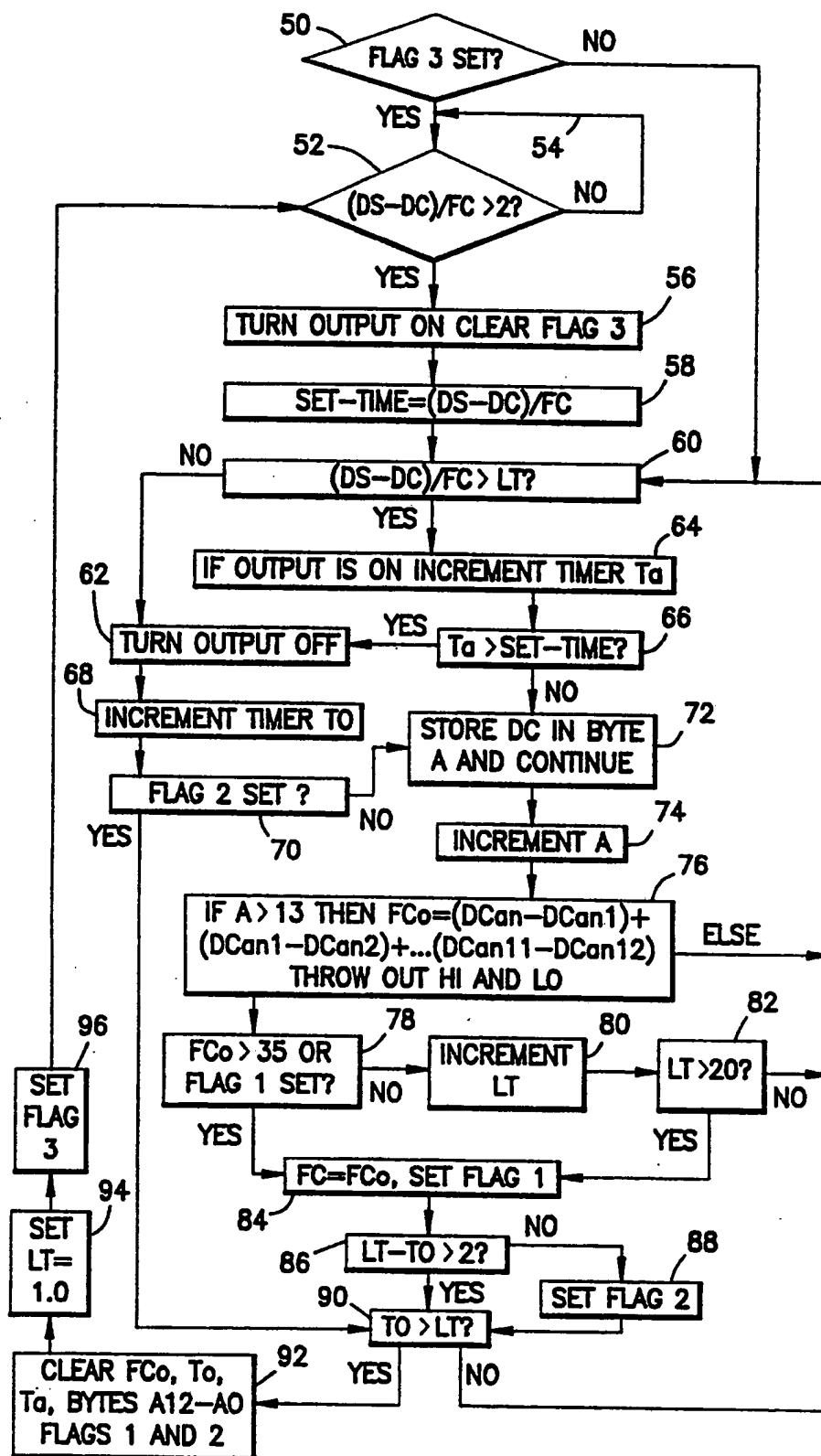


FIG. 2



**FIG. 3**

## INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 92/09051

<b>I. CLASSIFICATION F SUBJECT MATTER</b> (If several classification symbols apply, indicate all) <sup>6</sup>		
According to International Patent Classification (IPC) or to both National Classification and IPC		
Int.Cl. 5 A47L15/44; D06F39/02		
<b>II. FIELDS SEARCHED</b>		
Minimum Documentation Searched <sup>7</sup>		
Classification System	Classification Symbols	
Int.Cl. 5	A47L ; D06F	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched <sup>8</sup>		
<b>III. DOCUMENTS CONSIDERED TO BE RELEVANT<sup>9</sup></b>		
Category <sup>9</sup>	Citation of Document, <sup>11</sup> with indication, where appropriate, of the relevant passages <sup>12</sup>	Relevant to Claim No. <sup>13</sup>
A	EP,A,0 229 038 (ECOLAB INC) 15 July 1987 see the whole document	1,8
A	US,A,4 756 321 (J.W. LIVINGSTON ET AL.) 12 July 1988 see the whole document	1,8
<p><sup>9</sup> Special categories of cited documents : <sup>10</sup></p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>"&amp;" document member of the same patent family</p>		
<b>IV. CERTIFICATION</b>		
Date of the Actual Completion of the International Search		Date of Mailing of this International Search Report
29 JANUARY 1993		22. 02. 93
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**ANNEX TO THE INTERNATIONAL SEARCH REPORT  
ON INTERNATIONAL PATENT APPLICATION NO.**

US 9209051  
SA 66808

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